Studying the Use of Formalized Methodology to Design and Develop Computer Games

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Abstract
This paper evaluates a formalized game development methodology using the context of the creation of an end-user modification to an existing game engine.

This paper documents design and development of the modification, presents a critical analysis of the product produced, and suggests revisions to the methodology employed. With the array of challenges inherent in game design, there is a need to develop a well researched and formal methodology to allow development teams to create innovative products at an efficient rate. The methodology used here is the MDA framework (standing for Mechanics, Aesthetics, and Dynamics). It was authored by two Northwestern graduate students, Robert Hunicke and Robert Zubek, in collaboration with Marc Leblanc, technical director of the game studio MindControl.

Introduction
The process of designing and developing games remains almost as obscure as it did 30 years ago, remaining a science still very much in its developmental stages. In comparison, the technology powering games has grown exponentially so that most modern games demand real time processing for state of the art graphics, sound and artificial intelligence, as well as low latency network synchronization for multiplayer components. Games need to be intuitive, flexible to user demand, stable on a wide range of platforms and error free. On the artistic side, a game faces most of the challenges of a Hollywood production with the added complexity of user interaction. In development, a team must seamlessly integrate both art and technology to produce a successful product within a reasonable budget and time frame.

The MDA Framework
The framework was introduced to our team during Ken Forbus's game design course in the spring of 2003, during which Marc Leblanc was hosted as a guest speaker. Mr. Leblanc discussed the main points of his development method, which is described as follows. Game design is divided into three main categories:
1. Mechanics describes the basic elements used in the game.
2. Dynamics describes how the player interacts with the program
3. Aesthetics describes the result of the player interaction

A useful metaphor for describing the category interaction is the idea of a "car" product. First, we manufacture the car and all its component parts and deliver these to the user, the "mechanical" aspect. The user then uses the car to achieve a purpose in their environment, i.e. driving to work or getting groceries, the user "dynamic" aspect. Finally, the user reflects on their feelings from driving the car, the "aesthetic" aspect.

Players experience a game from the aesthetic viewpoint first, which reflects the dynamics and mechanics. Designers take the opposite viewpoint - the mechanics should power needed dynamics that reflect a desired "fun" aesthetic. Fun is quantized into 8 different categories: Sensation, Fantasy, Narrative, Challenge, Fellowship, Discovery, Expression and Submission. Each requires a different type of dynamic and aesthetics. Game development should view the quantized aesthetic as the program's requirements, and derive all development from this basis.

Project Design
The final project of the aforementioned game design class was the design and implementation of a small game, using the techniques taught during the course. My team chose to create an end-user modification on an existing engine. By using software provided by the developer, a team can modify, or "mod" an existing game

engine, allowing amateur developers to create new content without having to develop or license a new engine (a task that takes multiple years, or in the case of licensing, millions of dollars). Given the ease and speed which content can be created, these mods are a natural tool for teaching game design, and in our case proved to be an excellent environment for implementing the MDA framework.

We chose to use the MDA framework for a number of important reasons. First, the framework provides an excellent semi-formalized top-down structure for game creation, which is not provided in less structured frameworks. This allows development to progress in a much more focused basis. Second, the framework does not seek to quantize every individual element that a game should have, which was important in due the experimental nature of our project.

The first objective of this project was the creation of a playable version of the game within the assigned 5 week period. Given this short time frame, design and development would need to proceed extremely rapidly. The first choice was which game engine we would modify-since I had previous experience with Epic Game's "Unreal" franchise, we selected Epic Game's Unreal Tournament 2003 (UT2003) as the platform for development. The next step was creating a concept for the game. Our main aesthetic goals were to encourage human players to cooperate against a computer enemy (*Fellowship*), create high tension and intuitive game play (*Challenge, Sensation*), and to encourage re-playability (*Discovery*). Our next goal was deciding how the dynamics of the game would fulfill the aesthetic goals. To encourage Fellowship, we specified a small number of human players (1-6) to fight against a large number of weaker robotic enemies, with a system of multiple "classes" to ensure a system of dependent strength and weakness in every team. To produce our Challenge and Sensation, we used a timer and reward

system. To receive bonus health and ammunition, the human team would need to defeat all enemies in a 60 second "wave" period. This allowed for a natural cycle of low tension at the beginning of a wave, which built to a climax as time expired, and a rest period before the next wave was introduced. Furthermore, each subsequent wave introduced more difficult enemies, creating a large-scale tension cycle as the game progressed. To encourage Discovery, in addition to the aforementioned player classes, we implemented custom weapon selection, an experience system which would upgrade each player's weapons (incentive to play to unlock all the upgrades), and a wide a variety of enemies to ensure the need for a wide array of different strategies.
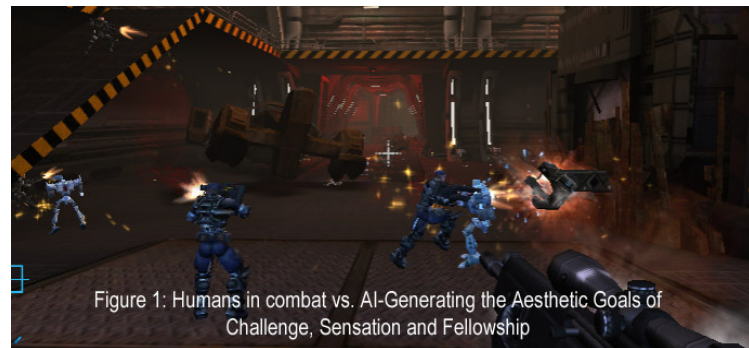

Figure 1: Humans in combat vs. AI-Generating the Aesthetic Goals of Challenge, Sensation and Fellowship

Development and Results
The first build of our project, named UETF Chronicles, was released in June 2004. UETF Chronicles has continued in development for over 24 months, completing 4 public downloadable beta releases. The original design premise has been greatly expanded, following the MDA framework.

It is hard to measure the success of the mod in purely empirical terms, as there is no large base of data to measure our performance against. However, we can present a few subjective examples of the mod's success:

Over 6000 public downloads for most recent public Beta release, and an estimated total of 11,000 downloads combined for all public

releases;

Winner of multiple awards in the Epic Games and Nvidia "Make Something Unreal Contest", including
- Second Prize Winner for "Best Game-type", Phase 1 of the N-Vidia "Make Something Unreal Contest"
- Finalist for "Best FPS Mod", Phase 2 of N-Vidia "Make Something Unreal" Contest.
- Education Award Finalist, representing Northwestern University, N-Vidia "Make Something Unreal" Contest.
- Honorable Mention for "Best FPS Mod", Phase 4 of N-Vidia "Make Something Unreal" Contest.
- Gamespy Industries Hosted Site, Official Gamespy Representative at the 2004 Los Angeles Electronic Entertainment Exposition
- Featured modification in December 2004 article of PC Games magazine

A quick analysis suggest that the MDA framework served us very well in creating a quality product that received considerable praise from both the target audience and industry critics. However, we cannot state that we achieved optimal results with the framework, as we encountered several significant issues that hampered our development (discussed below). Although the MDA framework was well suited for our initial design plans, our long term results highlighted several areas where the framework may need revision.

Project and Methodology Analysis
This section will be devoted to an analysis of the project development based on the MDA framework. We will examine the mechanics, dynamics and aesthetics of the project and assess the critical factors that contributed to the success or failure of each element. In creating this analysis, we had to face the problem that it is inherently difficult to gather statistical data on any aesthetic product. Because this project was not conceived as a research project, we did not institute any formal research procedures for gathering data. Our analysis then relies on several informal methods for gathering aesthetic data. Our primary sources were:
- Official postings (news sites, published material)
- Internal team testing
- Comments on news sites from users
- Comments related to our download link posted on various download sites
- Forums, UT official forum and UETF official forum
- In-formal feedback contest
- Playing/watching games on the official UETF server

This data is in no way statistically significant, as our sample population is heavily skewed toward the more active and verbal portion of our user base. It is interesting to note, however, that the presented data sources would be similar to what a publicly released game would have access to. So although we do not necessarily have a completely accurate picture of our audience response, we can create some idea of what our audience is feeling.

To interpret this raw data we collected, we used the MDA framework as the basis for classifying our results. First, we divide them by category. A post about being unable to set key bindings would fall under game mechanics, while a post about a new defensive strategy would fall under dynamics. After dividing out main categories, we can sub-classify the remaining data. For example, a forum post describing a fun 6-player experience would be a plus for the aesthetic goal of fellowship. A negative for fellowship would be a post about how one player took all the extra ammo and left none for the team. By compiling all the data we received, we can get a rough feel as to the success or failure of our project to achieve a particular aesthetic goal.

The first section is our mechanical analysis. I will not go in depth on the individual

mechanics used in our development because it would take a good deal of space and is very project specific. Our basic game-play mechanics have been briefly discussed above in the development section. Instead, I will focus on a few points that I feel are not well contained in the existing MDA framework.

The majority of our negative mechanical feedback was directed primarily at the experience *before* the player began playing. For free content (mods) in particular, the target audience is not required to make any financial investment, so any user friction, even having to wait for downloads, can deter a large portion of the audience. In our case in particular, the majority of feedback was extremely positive during the actual game-play, but the process of making it to this point (downloading, installing, setting player options) without errors frustrated many players. I feel that this needs to be recognized as an element in the MDA framework. Simply put, any time the user interacts with your product, you are creating an aesthetic experience. For example, if you are trying to draw the user into your game experience environment, using the default installer package does not draw the user into aesthetic experience like a custom installer with embedded pictures, music and even storyline elements (See Warcraft 3 example below). Likewise, if the user experiences frustration with your product, it will be the aesthetic feeling that becomes attached to it. Therefore, an important addition to the mechanics aspect is to cover not only the experience the user has while in the game world, but the user experience as a whole.

Next we analyze the dynamics of the project, or the results of player interaction with the program. We found in our development that this was the most unpredictable element of the framework. It is relatively simple to modify the mechanics, but difficult to create a specific dynamic interaction. We found the best way to measure dynamics is with a varied beta testing team. After observing the dynamics

that developed during the test sessions, we could then classify whether the mechanics driving the observed dynamics were adding to or detracting from our aesthetic goals. One key point we noticed is that dynamics tend to shift as veteran testers develop experience with the game, which is described in greater detail in the next section.

Last, we analyze the aesthetic presentation of the project, or the end user experience.

We had varied results in meeting our 4 aesthetic goals (*Fellowship, Challenge, Sensation and Discovery)*. We were most successful in Sensation, as the dynamics we originally designed resulted in very positive aesthetic feedback from the audience, suggesting we succeeded in creating the high tension environment we were seeking. We received mixed results on Fellowship; our original mechanics provided a dynamic inadequate for the level of Fellowship we were seeking, but subsequent changes in mechanics, such as encouraging players to stick together by providing added bonus powers when teammates are in close proximity, have had been able to raise this closer to the desired level. The success that we have achieved in this area suggests that sufficient revision in mechanics will allow us to meet this goal. The last two aesthetics, Discovery and Challenge, have proved to be the greatest challenge. For new players, it is a fairly easy to present plenty of content to explore. The problem is that once a player has completed the 4-6 hour campaign, there is little left to contribute to the discovery aspect. The same problem exists for the challenge aspect – it degrades with greater time played. This leads us to highlight a weakness in the MDA framework: previous experience *fundamentally alters the dynamics conveying the aesthetic.* For example, a slower paced level for beginning players provides a good environment for Discovery, while still producing Challenge and Sensation. In contrast, a player who has already completed this first level several times will find little new to discover and

little challenge in beating it. There seems a need for the design methodology to take into account the change in dynamics due to play experience.

Modifying the Methodology
In light of our experience, we find that there is a need to modify the MDA framework. In specific, although we followed the framework in our design, our product still failed to meet our goals in specific areas. Most notable was the failure of our mechanics to minimize player frustration and the aesthetic failure to produce a suitable level of Discovery. This has prompted me to propose two revisions to the framework.

The End User Environment
The first revision is the creation of an "end user environment" to be created within the dynamic level. The premise of this environment is as follows (see figure 2): Aesthetics and Dynamics are derived from the end user environment. Players cannot directly enter the end user environment, as there is always some type of requirement before entering this environment (i.e. installation, reading the manual, loading the game). Therefore, as well as conveying the aesthetic, mechanics must streamline the entrance to the environment and prevent any un-wanted exit from the environment.

Figure 2:

Mechanics ——▶ End User Enviroment
                              │
                              ▼
                        Dynamics ——▶ Aesthetics
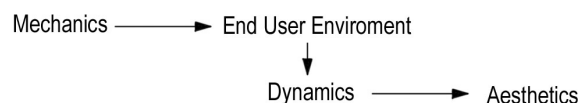
To help illustrate this, I will refer to Blizzard Entertainment's Warcraft 3 multiplayer matchmaking service. Unlike many games where the multiplayer connection process is completely disconnected from the rest of the user experience, the Warcraft 3 service is an aesthetic experience in itself. On the backdrop of an ominous rain streaked sky, heavy iron gates clang open and shut signaling your entry into the Warcraft 3

online battlefield (see figure 2a). Each player has a unique player avatar, depicting their skill and side of choice (see figure 2b). A menacing green eye searches for an appropriate field of battle, and a loud drum-roll signals your entrance into the fray. All of these serve to enhance the aesthetic goal of sensation, drawing players deeper into the end user environment rather than forcing an unwanted exit.

Figure 2a. The Warcraft Multiplayer Menu
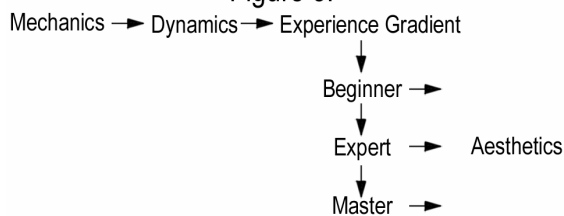

Figure 2b. The Warcraft 3 Multiplayer Avatar

The Experience Gradient
The second revision is the addition of an experience gradient as a filter to the aesthetic (see figure 3). As noted above, experience alters the way dynamics shape a game. To adjust for this, designers should view their audience as being composed of discrete levels. I propose that all players in a game can be divided into 3 categories, beginners, experts and masters. Beginners are those still mastering the basic fundamentals of the game. Experts have mastered all the fundamentals, but still in the process of discovering more advanced techniques. Masters have learned every technique and look to find all possible content and to distinguish themselves from their peers. Naturally, the composition of

your audience will begin with mostly beginners, and end with a mostly experts and masters. Each aesthetic goal must be evaluated in regards to every experience level. What creates challenge for a beginner will bore a master, while what challenges a master will frustrate a beginner. Mechanics such as variable difficulty, un-lockable or hidden content, or a logarithmic reward system should be used to ensure that aesthetic goals are met for every experience level.

Figure 3:

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Mechanics → Dynamics → Experience Gradient
                                    ↓
                          Beginner →
                                    ↓
                          Expert  →        Aesthetics
                                    ↓
                          Master  →
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One very visible example of the need of the experience gradient is the skill level difference in MMORPGs, such as Blizzard Entertainment's World of Warcraft. Although beginning players were treated to a huge and diverse game world, a major complaint was that the game lacked end game content. In terms of the MDA framework, it fulfilled the aesthetic goals of discovery and challenge at the beginner level, but failed to meet these goals at the master difficulty level. While Blizzard has begun to expand end-game content to fix this problem, many expert players have chosen not to reach the master level due to the lack of the discovery aesthetics and the frustration due to the challenge dynamic (expert players are easily killed by master players). By applying the MDA framework with the experience gradient, the game experience could have been improved by making sure that the aesthetic goals were planned for in all the experience levels.

Conclusion
It is always hard to find conclusive results when there is a lack of a standardized measurement or comparative data. We cannot represent on a purely empirical scale the success or the failure of the UETF

Chronicles. However, we can use the data we have to generate a rough evaluation of the success of this project, employing factors such as general community interest, feedback from the user community and critique from the industry. From this, we conclude that using the MDA framework greatly assisted us in creating an initial design for our game-play. Using the MDA framework helped focus us on specific goals, simplifying the creation of the needed dynamics and mechanics. However the framework failed to account for what we see as critical factors in the later stages of development, most notably in creating mechanics to keep the user in the aesthetic space and failing to account for player experience changing the aesthetic outcome. I feel the modifications I have proposed to the framework will address these problems for future developers, as our team has already started using the modified framework to create an improved version of UETF Chronicles. I believe that further research like the type we conducted is needed to develop a unified formal methodology. Finally, I feel that this unified formal methodology will play a key role in increasing the quality and diversity of the exciting new medium of interactive media.

Sources
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